Reaction Time Differences in Real and Simulated Driving

Decreasing car production cycles: Evaluation problems

- Shorter and shorter time-to-market cycles (>4 years → <18 months)
- Increasing number/complexity of driver assistance systems and control instruments
- Simulation (e.g. crash/wind tunnel tests) is required to meet deadlines — no longer time for real tests
- Complexity of person behavior: **Problems in using simulation to cover user interface evaluation** (however, first approaches are arising; published for instance by Santos *et al.* or Panerai *et al.*)

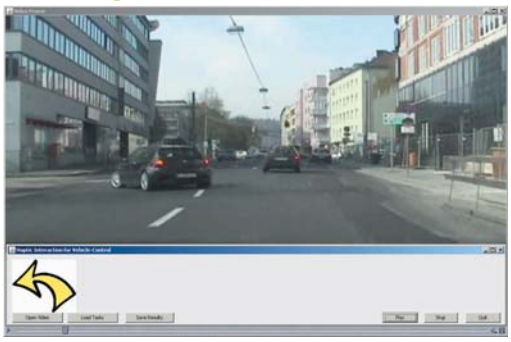
Seat with 2x8 vibro-tactile elements (used for simulation and in real studies)

Research question

To what extent can **driving simulators be used to serve as cheap and easy realizable environments for simulating on-the-road behavior** (e.g. for measuring reaction times)?

- Two similar experiments using either vibro-tactile, auditory or visual driver notification
- Reaction times were measured and compared between the two series

(i) Driving Simulator



Trip length 21km, driving time 30min., 44 events triggered trace-driven

Real Driving Study (ii)

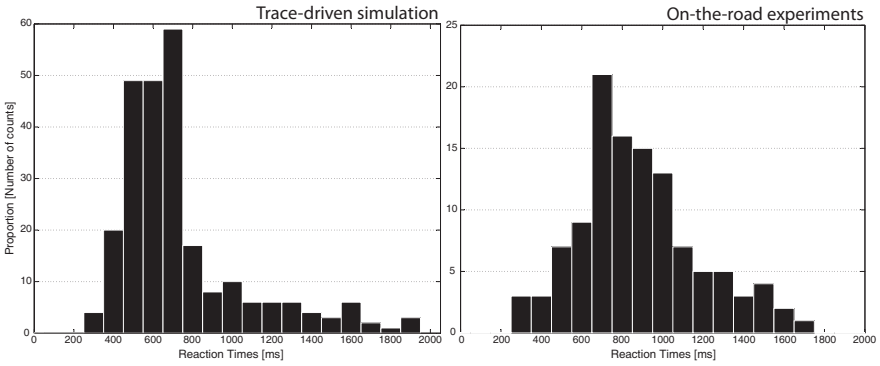
Trip length 26km, driving time 34min., 35 events triggered manually by the experimentator

Preliminary results

- **Both settings provide similar results for the order of average response using the three modalities**
- **Simulation performed better (by reason of the simpler setup compared to the real world setting)**

Attribute	Reaction time *(ms)* $\overline{x}_{TD}$	Reaction time *(ms)* $\overline{x}_{R}$	Diff. *(%)* $\overline{x}_{TD \to R}$	Order TD, R
CI 5% [752 trace-driven (TD), 353 real (R) datasets]				
Combined	889.2	1,003.2	12.82	-,-
Visual	784.3	978.7	24.79	2,2
Auditory	1,129.6	1,179.5	4.41	3,3
Vibro-tactile	690.6	879.9	27.41	1,1

Increased average reaction times and standard deviation for real-driving journeys compared to trace-driven simulation



The shape of the plot (vibro-tactile modality) shows that reaction times are lower with less variation for the case of simulation compared to real-driving studies

Further work

- Experiments with a more sophisticated simulator providing an immersive environment (road vibrations, engine noise, penalty models for speeding, etc.)
- Conducting real-driving studies on test routes with pedestrians and uninvolved cars removed (focus on the task of driving)

Acknowledgements: This work is supported under the FP7 ICT Future Enabling Technology programme of the European Commission under grant agreement No. 231288 (SOCIONICAL)

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